NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

July 20, 2010

Flight Data Recorder - 10

Specialist's Factual Report

1. EVENT SUMMARY

Location: Charleston, WV
Date: July 13, 2009
Aircraft: B737-300, N387SW
Operator: Southwest Airlines, Flight 2294
NTSB Number: DCA09FA065

At about 1745 EDT, Southwest flight 2294, a Boeing 737-3H4 (N387SW), experienced rapid decompression while in cruise flight. The decompression was caused by an approximate 1.5 square foot hole in the crown fuselage skin near passenger row 20. The passenger oxygen masks deployed automatically, the flight crew declared an emergency and the flight landed uneventfully at Yeager Airport, Charleston, West Virginia (CRW). The flight departed Nashville, Tennessee (BNA) and was scheduled to fly to Baltimore, Maryland (BWI).

2. FLIGHT DATA RECORDER GROUP

A flight data recorder (FDR) group was not convened.

3. DETAILS OF FLIGHT DATA RECORDER INVESTIGATION

On July 15, 2009, the Safety Board's Vehicle Recorder Division received the following FDR:

Recorder Manufacturer/Model: **Honeywell SSFDR, Model 980-4700**
Recorder Serial Number: **11210**

The recorder was in good condition and the data were extracted normally from the recorder.

3.1. Recorder Description

The Honeywell Solid State Flight Data Recorder (SSFDR) records airplane flight information in a digital format using solid-state flash memory as the recording medium. The SSFDR can receive data in the ARINC 573/717/747 configurations and can record a minimum of 25 hours of flight data. It is configured to record 64 12-bit words of digital information every second. Each grouping of 64 words (each second) is called a subframe. Each subframe has a unique 12-bit synchronization (sync) word identifying it as either subframe 1, 2, 3, or 4. The sync word is the first word in each subframe. The data stream is ""in sync"" when successive sync words appear at proper 64-word intervals. Each data parameter (e.g. altitude, heading, airspeed) has a specifically assigned word number

within the subframe. The SSFDR is designed to meet the crash-survivability requirements of TSO–C124.

3.2. FDR Carriage Requirements

Federal regulations regarding the carriage requirements of FDRs on aircraft can be found in the following regulations: 14 CFR 121.343, 14 CFR 121.344, 14 CFR 121.344a and 14 CFR 135.152. In general, for turbine-powered transport category aircraft manufactured on or before October 11, 1991, an FDR must be installed on board that records a minimum of 18 parameters, and for those turbine-powered aircraft that seat between 10 and 19 passengers, the minimum is 22 parameters. Newly manufactured aircraft are required to be equipped with an FDR that records a minimum of 88 parameters. Specifically, the incident aircraft, N387SW, was operating such that it was required to be equipped with an FDR that recorded 34 parameters, as cited in 14 CFR 121.344.

3.3. Recording Description

The FDR recording contained approximately 105 hours of data. Timing of the FDR data is measured in subframe reference number (SRN), where each SRN equals one elapsed second. The incident flight was the last flight of the recording and its duration was approximately one hour.

3.4. Time Correlation

The event flight data has been offset from SRN to local eastern daylight time (EDT) using the recorded GMT parameter on the FDR and then adjusting the time for EDT. The offset from SRN to EDT was -314090 seconds.

3.5. Engineering Units Conversions

Based upon consultation with Southwest Airlines, the data frame configuration applicable to this aircraft's FDR system was a 737-5. The reference documentation to convert the data from binary values into engineering units is contained within Boeing document D226A101-1. Where applicable, changes to the conversions have been made to ensure the parameters conform to the Safety Board's standard sign convention that climbing right turns are positive (CRT=+).[1]

3.6. FDR System Malfunction

Once the data were converted, it became apparent that there were many parameters not recording valid data, including fundamental parameters such as computed airspeed, pitch attitude, roll attitude, and magnetic heading. The sources for the bad parameters were identified and the airline was asked to perform an FDR system check on the aircraft. Airline maintenance personnel identified a connector (D8907P) which runs into the Digital Flight Data Acquisition Unit (DFDAU) that was poorly seated. The data recorded on the FDR is fed by the DFDAU so this resulted in the loss of valid data for all parameters using this connector. The aircraft manufacturer, Boeing, was consulted in order to determine

[1] CRT=+ means that for any parameter recorded that indicates a climb or a right turn, the sign for that value is positive. Also, for any parameter recorded that indicates an action or deflection, if it induces a climb or right turn, the value is positive. Examples: Right Roll = +, Left Aileron Trailing Edge Down = -, Right Aileron Trailing Edge Up = +, Pitch Up = +, Elevator Trailing Edge Up = +.

exactly which parameters would have been affected with a poor connection and thus produce invalid data. Those parameters were excluded from this report.

3.6.1. Parameters Provided and Verified

The following table lists the FDR parameters provided and verified in this report, including the associated plot label.

Table 1. Verified and Provided FDR Parameters	
Plot Label	**FDR Parameter**
1. Accel Lat (g)	Lateral Acceleration (g)
2. Accel Long (g)	Longitudinal Acceleration (g)
3. Accel Vert (g)	Vertical Acceleration (g)
4. Altitude Press (ft)	Pressure Altitude (feet)
5. AOA (deg)	Angle of Attack (degrees)
6. AP	Autopilot (discrete)
7. Cabin Alt Warn	Cabin Altitude Warning (discrete)
8. Eng1 N1 Non-EIS (%RPM)	Engine 1 N1 Non-EIS (%RPM)
9. Eng2 N1 Non-EIS (%RPM)	Engine 2 N1 Non-EIS (%RPM)
10. Flaps TE-L (deg)	Flaps Trailing Edge Right (degrees)
11. Flaps TE-R (deg)	Flaps Trailing Edge Left (degrees)

3.6.2. Pressure Altitude

This FDR records pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (in Hg). The pressure altitude information presented in the FDR plots and in the electronic data has not been corrected for the local altimeter setting at the time of the event.

3.7. FDR Plots and Corresponding Tabular Data

The following plot contains FDR data recorded during the July 13, 2009 event and table 1 lists all of the FDR parameters plotted.

The data show that the aircraft took off and climbed for about 25 minutes to an altitude of approximately 34,500 feet when, at 17:39:04, the Cabin Altitude Warning parameter indicated a warning and the autopilot turned off. Over the next 6 minutes, the aircraft descended to an altitude of approximately 11,000 feet. The aircraft began to descend again about 6 minutes later and the Cabin Altitude Warning parameter turned off as the aircraft was passing through 8,100 feet. The aircraft landed uneventfully at 18:06:29.

This plot is configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page. The corresponding tabular data used to create this plot are provided in electronic (.csv) format as Attachment 1 to this report.

Erin Gormley
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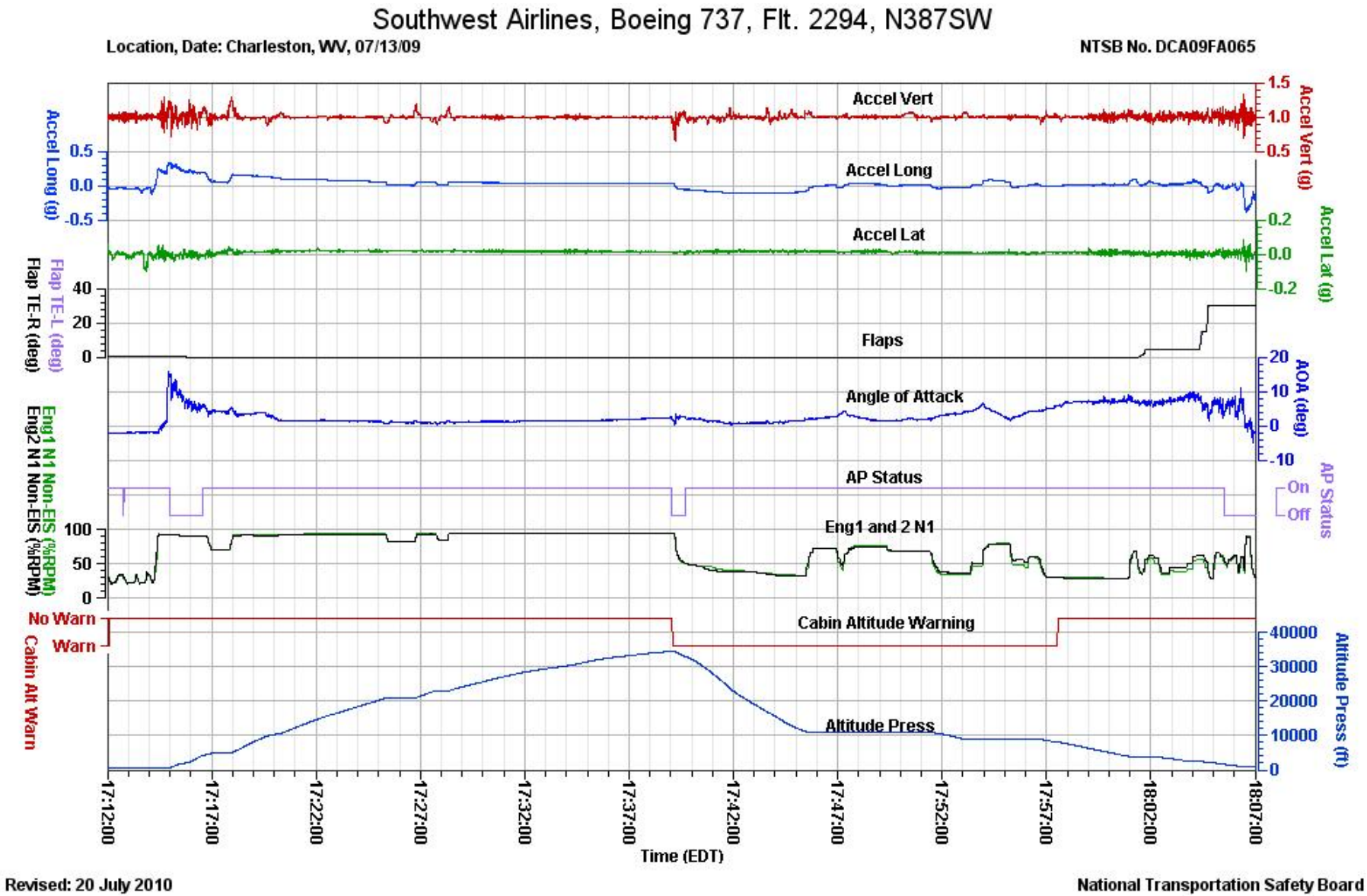
Plot 1


Southwest Airlines, Boeing 737, Flt. 2294, N387SW
Location, Date: Charleston, WV, 07/13/09
NTSB No. DCA09FA065
Accel Vert
Accel Long
Accel Lat
Flaps
Angle of Attack
AP Status
Eng1 and 2 N1
Cabin Altitude Warning
Altitude Press
Accel Long (g)
Accel Vert (g)
Accel Lat (g)
Flap TE-L (deg)
Flap TE-R (deg)
AOA (deg)
AP Status
On
Off
Eng1 N1 Non-EIS (%RPM)
Eng2 N1 Non-EIS (%RPM)
No Warn
Warn
Cabin Alt Warn
Altitude Press (ft)
17:12:00
17:17:00
17:22:00
17:27:00
17:32:00
17:37:00
17:42:00
17:47:00
17:52:00
17:57:00
18:02:00
18:07:00
Time (EDT)
Revised: 20 July 2010
National Transportation Safety Board